Transverse Expansion and High p_T Azimuthal Asymmetry at RHIC *

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Preliminary STAR data from RHIC suggest a large transverse azimuthal asymmetry $v_2 \sim 0.10 - 0.15$ at moderate high $2 < p_T < 5$ GeV/c. In an earlier work, we proposed that the saturation of $v_2(p_T)$ could be interpreted as a manifestation of asymmetric jet energy loss that arises due to the different jet propagation path lengths in non-central ($\mathbf{b} > 0$ fm) collisions of heavy ions. We applied the GLV energy loss formalism to compute the asymmetry and found that under the approximation that the initial spatial asymmetry of the plasma (generated by intersecting sharp cylinders) did not change with time the observed high p_T v_2 could be explained by asymmetric jet quenching. The initial gluon rapidity density when extrapolated to central collisions was estimated to be $dN_g/dy(\mathbf{b} = 0 \text{ fm}) \sim 1000$.

We have parametrized the non-perturbative low p_T component in terms of hydrodynamic solutions that fit well the observed $p_T < 2$ GeV/c flavor dependent inclusive distributions for pions and nucleons. We ignored, however, the additional rapid dilution and time dependent spatial asymmetry of the plasma that is predicted by hydrodynamic transverse flow. Boosted thermal model fits to the low p_T data suggest that the collective transverse flow velocities may be quite high at RHIC with $v_T \sim 0.6$. The purpose of this letter is to compute the effect of such 3+1D expansion on the azimuthal asymmetry of the jet quenching pattern. We find that while in extreme scenarios, assuming instantaneous transverse expansion of the medium, the geometric azimuthal asymmetry is strongly reduced, the overall magnitude of the mean energy loss ΔE is much less sensitive for flow velocities up to $v_T = 0.8$. We also speculate about different non-perturbative effects on moderate p_T meson and baryon production that could lead to different flavor dependent high p_T v_2 behavior.

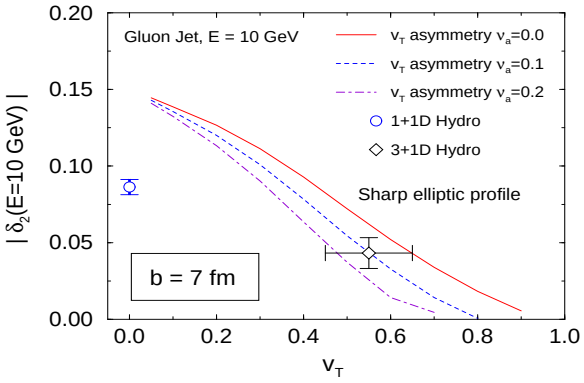

Figure 1: The second harmonic of the jet energy loss for a 10 GeV gluon propagating through a 3+1D elliptic expanding plasma as a function of the mean transverse flow velocity, v_T.

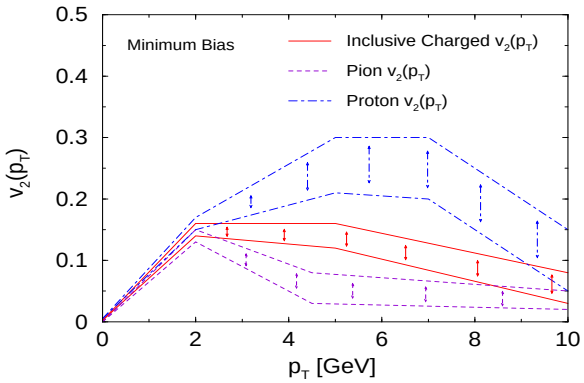

Figure 2: Qualitative illustration of the $v_2(p_T)$ behavior for pions, protons and inclusive charged particles.

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